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The Cladoniae of New Jersey¹

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In certain parts of New Jersey, particularly in the pine barrens and in sheltered localities along the coast, the *Cladoniae* constitute an important and conspicuous part of the vegetation. The largest and most striking of the species belong to the subgenus *Cladina*, which includes the so-called "reindeer mosses," and to the subsection *Unciales* of the subgenus *Cenomyce*. In many regions species belonging to these two groups grow in large tufts or mats and cover over extensive areas, either by themselves or in association with herbaceous plants or low shrubs. Another group, the section *Cocciferae* of the subgenus *Cenomyce*, is characterized by scarlet apothecia, which are especially vivid in moist weather. Although the species of this group are less robust than the *Cladinae* and *Unciales*, they readily attract attention. The remaining species are brown-fruited forms belonging to the subgenus *Pycnothelia* and to the subsections *Chasmariae* and *Clausae* of the subgenus *Cenomyce*. A few of these may be as large as the *Cladinae* and *Unciales*, but the majority are smaller and relatively inconspicuous. Perhaps the most striking among them are those with cups, which may be wide open or closed by continuous membranes.

One of the earliest botanists, if not the earliest, to study the *Cladoniae* of New Jersey was C. F. Austin of Closter, Bergen County, who collected extensively in the vicinity of his home town. The first published references to his specimens are apparently those in Tuckerman's *Genera Lichenum* (20), which appeared in 1872. Two species, *C. mitrula* and *C. lepidota*, are here accredited to the state on the authority of Austin. A few years later Austin prepared a list of the New Jersey lichens

¹ Contribution from the Osborn Botanical Laboratory.

which he had found, and this list was published in Britton's *Preliminary Catalogue of the Flora of New Jersey* (2), which was issued in 1881. Austin's list, which was based on determinations made by Tuckerman, includes seventeen species of *Cladonia*, all but one from the vicinity of Closter.

Tuckerman's *Synopsis of the North American Lichens* (21), published in 1882, definitely accredits only five species of *Cladonia* to New Jersey, all of which are included in Austin's list. The records for four of these are based on Austin's material, the record for the fifth on specimens collected by Miss Biddlecome. No definite stations are mentioned.

In 1889 Britton published his *Catalogue of plants found in New Jersey* (3). For this work Austin's list of lichens was revised and amplified by Eckfeldt, who recognized twenty-one species of *Cladonia* for the state. For most of the species the New Jersey distribution is given by counties, but more definite stations are listed in certain cases.

Two years before the publication of Britton's Catalogue the first part Vainio's *Monographia Cladoniarum universalis* (22) made its appearance, the second part followed in 1894, and the third in 1897. The records for New Jersey in this important work are quoted directly from Tuckerman's Synopsis and give no additional information about stations. Vainio's monograph describes the species of *Cladonia* for the entire world and quickly became the standard authority for students of the genus. In the case of certain species the author presented views which were at variance with those previously held and emphasized characters which had hitherto been considered unimportant. It is not surprising, therefore, that some of the records in Austin's and Eckfeldt's lists are in need of revision. This is particularly true of species which have not been subsequently found in New Jersey. The writer has examined the New Jersey *Cladoniae* in the Tuckerman Herbarium at Harvard University, in the Austin collection of lichens at the New York Botanical Garden, and in the Eckfeldt Herbarium at the Philadelphia Academy of Natural Sciences, and has thus been able to make the necessary revision in certain cases by the study of the specimens upon which the records were based. There are, however, three species in the Eckfeldt list of which no specimens from New Jersey have been seen. These species are the following: *C. cornuta* (L.)

Fr., listed from Bergen and Warren Counties; *C. rangiferina* var. *alpestris*, now *C. alpestris* (L.) Rabenh., listed from the Pine Barrens; and *C. leporina* Fr., listed from Atco, Camden County. For the present, therefore, the occurrence of these three species in New Jersey must be considered doubtful.

For about forty years after the appearance of Britton's Catalogue the *Cladoniae* of New Jersey received but little attention. Collections, to be sure, were made from time to time by various botanists; but little, if anything, was published about these collections. In the last few years, however, interest in the *Cladoniae* of North America has been revived, and several papers dealing with the species of New Jersey have made their appearance. The most important of these is a report by Torrey on the *Cladoniae in the range of the Torrey Botanical Club* (18). In this report nineteen species are recorded from New Jersey, and definite stations are given for several of these species. Another interesting paper is by Lutz, who includes a list of thirteen species of *Cladonia* in his report on *the Ecological relations in the Pitch Pine Plains of southern New Jersey* (8). Other papers will be referred to in connection with the records for individual species.

In addition to Torrey's report, which contains descriptions, keys, and illustrations, several other papers have recently appeared on the *Cladoniae* of the eastern United States. These include a paper on *C. Beaumontii* by Robbins (10), a paper on *C. lepidota* by the same author (11), a report by the writer on the *Cladoniae of Connecticut* (4), two supplements to this report (5,6), and an illustrated paper by Robbins and Blake on *Cladonia in the District of Columbia and vicinity* (12). Although most of these papers include no direct references to specimens of *Cladonia* from New Jersey, they treat numerous species and forms that are represented in the flora of the state. They are therefore included in the bibliography at the close of the present report.

The species in the following list are arranged according to the classification of Vainio (see 22), which has been adopted by most of the recent writers on *Cladonia*. The stations for the various species and forms are listed alphabetically, first by counties and then by localities under the counties, and will give some idea of the extent to which exploration for *Cladoniae*

within the state had progressed down to the close of 1934. Most of the records are based on specimens in the Yale Herbarium. Where this is not the case the place of preservation is indicated as follows: F., Farlow Herbarium, Harvard University (including the Tuckerman collection); N. Y., herbarium of the New York Botanical Garden (including the Austin collection); and P., herbarium of the Philadelphia Academy of Natural Sciences (including the Eckfeldt collection).

Descriptions and the citation of synonymy in the list are reduced to the lowest limits. They are given as a rule only in cases where the species or forms in question have not been treated in the recent American literature. Where they have been treated references are given, so that the necessary data can easily be found.

In the determination of the New Jersey *Cladoniae* the writer has received assistance from the late C. A. Robbins, of Onset, Massachusetts, and from Dr. Heinrich Sandstede, of Oldenburg, Germany; and records based on the determinations of these authorities are definitely noted. Specimens marked simply "1932" were collected by the writer in September of that year. These collections were made on an excursion to the Pine Barrens, under the guidance of Mrs. Gladys P. Anderson, Mr. and Mrs. W. G. Taylor, and Mr. R. H. Torrey (see Torrey, 16). Species and forms recorded for the first time from New Jersey are marked with asterisks (*), even if they may have been reported previously under different names.

The various collectors mentioned in the list, aside from the writer, are the following: Mrs. Gladys P. Anderson, L. W. Anderson, C. F. Austin, Miss H. F. Biddlecome, S. F. Blake, L. W. Bowen, N. L. Britton, G. F. Dillman, J. W. Eckfeldt, Miss Margaret Fulford, H. A. Green, Mrs. Carolyn W. Harris, E. P. Killip, E. C. and G. M. Leonard, H. L. Lutz, F. A. Musch, C. C. Plitt, Mr. and Mrs. W. G. Taylor, R. A. Torrey, and Miss H. A. Walker. It is hoped that the list may encourage further collection of *Cladoniae* within the state.

Subgenus 1. CLADINA

1. CLADONIA RANGIFERINA (L.) Web. (4, p. 375; 12, *pl.* 210, *f.* 1; 18, *pl.* 1, *f.* 1). On earth in fields and open woods and on thin soil over rocks. The species, as now restricted, is less abun-

dant in New Jersey than the published records might seem to indicate (3, p. 373). Most, if not all, of the New Jersey specimens bearing the name *C. rangiferina* in the Austin and Tuckerman collections represent *C. tenuis*, and no New Jersey specimens are present in the Eckfeldt collection. Torrey reports the species from the "Highlands" of New Jersey (18, p. 120), and Thompson lists it from the Wawayanda cedar swamp (14, p. 22). The New Jersey specimens seen by the writer are listed below, some of them as distinct forms. BURLINGTON: New Gretna (*Musch*, 1928, det. Robbins). OCEAN: Point Pleasant (*Plitt*, 1907, F.) and Wrangel Brook (*Torrey*, 1934). SUSSEX: Wawayanda Mountain, Vernon (*Torrey*, 1933).

1a.* CLADONIA RANGIFERINA f. CRISPATA Coem. (4, p. 377). PASSAIC: near Hewitt (*Dillman*, 1934).

1b.* CLADONIA RANGIFERINA f. STYGIA Fr. Sched. Crit. Lich. Suec. Exsic. 22. 1826. WARREN: among boulders on shore of Sunfish Pond, Kittatiny Mountain (*Torrey*, 1933, det. Sandstede); apparently the first record for North America. According to Sandstede this form grows in localities that are sometimes under water. The plants, in consequence, become blackened and more or less verruculose in the older parts.

1c.* CLADONIA RANGIFERINA f. PROLIFERA Flot. (4, p. 377). PASSAIC: near Hewitt (*Dillman*, 1934).

2. CLADONIA SYLVATICA (L.) Hoffm. (4, p. 378). On earth in fields and open woods. BURLINGTON: Batsto (1932) and West Plains (*Lutz*, 1932, see 8, p. 12). CAMDEN: Atco (*Eckfeldt*, 1882, F., P., listed in 3, p. 373, as *C. rangiferina* var. *sylvatica*). OCEAN: near Forked River (*Dillman*, 1933, det. Sandstede), Lakehurst (*Torrey*, 1934, det. Sandstede), Simplace (*Killip*, 1930), Davenport Branch of Tom's River (*Dillman*, 1934). PASSAIC: Skylands (*Britton*, 1917, N. Y., det. Riddle). WARREN: near Millbrook (*Torrey*, 1934). Austin's record for *C. sylvatica* (2, p. 164), under the name *C. rangiferina* var. *sylvatica*, was based on material of *C. tenuis*.

2a. CLADONIA SYLVATICA f. PYGMAEA Sandst. (4, p. 381). BURLINGTON: New Gretna (*Musch*, 1928, det. Robbins) and West Plains (*Lutz*, 1928, det. Sandstede, see 8, p. 12). OCEAN COUNTY: near Tom's River (*E. C. and G. M. Leonard*, 1928, det. Sandstede).

2b.* CLADONIA SYLVATICA f. DECUMBENS Anders, Hedwigia 61: 358. 1920. BURLINGTON: New Gretna (*Musch*, 1928, det. Robbins); apparently the first record for North America. The plants grew in depressed, subcircular mats and show a yellowish pigmentation.

3. CLADONIA MITIS Sandst. (4, p. 381; 12, *pl.* 210, *f.* 5; 18, *pl.* 1, *f.* 3). On earth in fields and open woods; reported from the "New Jersey Pine Barrens" by Torrey (18, p. 120). BURLINGTON: Brown's Mills (1932) and New Gretna (*Musch*, 1928, det. Robbins). OCEAN: Lahaway (*Torrey*, 1933, det. Sandstede), Laurelton (*Torrey*, 1934), Seaside Park (1932), and Davenport Branch of Tom's River (*Dillman*, 1934).

3a.* CLADONIA MITIS f. DIVARICATA Sandst. (4, p. 383). BURLINGTON: New Gretna (*Musch*, 1928, det. Robbins and Sandstede) and West Plains (1932, det. Sandstede).

3b.* CLADONIA MITIS f. PROLIFERA Sandst. (4, p. 383). BURLINGTON: New Gretna (*Musch*, 1928, det. Robbins) and West Plains (1932).

4. CLADONIA TENUIS (Floerke) Harm. (4, p. 384; 12, *pl.* 210, *f.* 3; 18, *pl.* 1, *f.* 2). On earth in fields and open woods; the most abundant species of *Cladina* in New Jersey. BERGEN: Closter (*Austin*, 1864, F., N. Y., listed in 2, p. 164, as *C. rangiferina* and as *C. rangiferina* var. *sylvatica*). BURLINGTON: Bass River State Forest (*Torrey*, 1934), Batsto (1932), Skit's Branch of Batsto River (*Torrey*, 1933), Brown's Mills (1932), and West Plains (*Lutz*, 1930, 1932, see 8, p. 12; *Evans*, 1932). CAMDEN: Atco (*Green*, 1882, P.). CUMBERLAND: Vineland (*Miss Walker*, 1893, N. Y., distributed in Cummings, Williams, and Seymour, Lich. Bor.-Amer. No. 63, as *C. rangiferina* var. *sylvatica*; referred by Merrill, 9, p. 91, to *C. sylvatica* f. *laxiuscula*). OCEAN: Bamber Lake (*Dillman*, 1934), near Barnegat (*E. C. and G. M. Leonard*, 1928), Dover Forge (*Dillman*, 1934), Hornerstown (*Torrey*, 1933), Lakehurst (*Torrey*, 1934), Lakewood (*Mrs. Anderson*, 1923), Laurelton (*Torrey*, 1934), Seaside Park (1932), near Tom's River (*E. C. and G. M. Leonard*, 1928), and Wrangel Brook (*Torrey*, 1934). PASSAIC: West Milford (*Torrey*, 1934). SUSSEX: Wawayanda Mountain, Vernon (*Torrey*, 1933). The

species is listed from the "Pine Barrens" by Torrey (18, p. 121).

4a.* *CLADONIA TENUIS* f. *SETIGERA* Sandst. (5, p. 123). OCEAN: Double Trouble (*Anderson*, 1934) and Hornerstown (*Torrey*, 1933). SUSSEX: Wawayanda Mountain, Vernon (*Torrey*, 1933).

Subgenus 2. PYCNOTHELIA

5. *CLADONIA PAPILLARIA* (Ehrh.) Hoffm. (4, p. 389). On sandy soil in exposed localities. In the New Jersey material of this common and variable species the three forms listed below are represented. The species is reported by Austin from Closter (2, p. 164), by Tuckerman from "New Jersey, Austin" (21, p. 245), by Eckfeldt from Bergen County and from Atco, Camden County (3, p. 373), by Vainio from "New Jersey, Austin" (22, p. 52), and by Torrey from the New Jersey Pine Barrens (18, p. 121). Eckfeldt's specimens from Atco are not preserved in his collection.

5a. *CLADONIA PAPILLARIA* f. *MOLARIFORMIS* (Hoffm.) Schaer. (4, p. 390; 12, *pl.* 210, *f.* 6, in part; 18, *pl.* 1, *f.* 4). Austin's New Jersey specimens of *C. papillaria* are referable to this form but are not definitely labeled "Closter," either in the Tuckerman collection or in the herbarium of the New York Botanical Garden. The following additional specimens of f. *molariformis* have been examined by the writer:—BURLINGTON: Bass River State Forest (*Torrey*, 1934), Brown's Mills (1932), Lower Bank (1932), and West Plains (*Lutz*, 1932, see 8, p. 12). MONMOUTH: Navesink (*Evans*, 1934). OCEAN: near Forked River (*Dillman*, 1933), Hornerstown (*Torrey*, 1933), Lakehurst (*Torrey*, 1934), Lakewood (*Mrs. Harris*, 1908, F.), and Wrangel Brook (*Torrey*, 1934). PASSAIC: Franklin Lake (*Torrey*, 1933).

5b.* *CLADONIA PAPILLARIA* f. *STIPATA* Floerke (4, p. 391). BURLINGTON: Lower Bank (1932). MONMOUTH: Navesink (*Evans*, 1934). PASSAIC: Franklin Clove (*Torrey*, 1933).

5c. *CLADONIA PAPILLARIA* f. *PAPILLOSA* Fr. (4, p. 391; 12, *pl.* 210, *f.* 6, in part). Often mixed with f. *molariformis*. BURLINGTON: Brown's Mills (1932), Lower Bank (1932), and West Plains (*Lutz*, 1932, see 8, p. 12). MONMOUTH: Navesink (*Evans*, 1934). OCEAN: Hornerstown (*Torrey*, 1933). PASSAIC: Franklin Lake (*Torrey*, 1933).

Subgenus 3. CENOMYCE

Section 1. COCCIFERAE

Subsection 1. SUBGLAUCESCENTES

6. CLADONIA FLOERKEANA (Fr.) Floerke (4, p. 392). On rotten wood and on thin soil over rocks. This species, according to Torrey (18, p. 121), is found "along New Jersey Pine Barren streams" and is usually represented by the following variety:—

6a. CLADONIA FLOERKEANA var. INTERMEDIA Hepp (4, p. 392; 12, *pl.* 210, *f.* 8; 18, *pl.* 1, *f.* 7). WARREN: Kittatiny Mountain (Torrey, 1933). The writer has no material of *C. Floerkeana* from the Pine Barrens.

7.* CLADONIA BACILLARIS (Ach.) Nyl. (4, p. 395; 18, *pl.* 1, *f.* 6). On logs, banks, and thin soil over rocks. BURLINGTON: Lower Bank (1932), New Gretna (Musch, 1928, det. Robbins), and Speedwell (1932). MONMOUTH: Navesink (Evans, 1934). MORRIS: Green Pond Mountain (Dillman, 1934). OCEAN: Barnegat Island (Torrey, 1934), Dover Forge (Dillman, 1934), Hornerstown (Torrey, 1933), Seaside Park (1932), Davenport Branch of Tom's River (Dillman, 1934), and near Whitings (Torrey, 1933). PASSAIC: West Milford (Torrey, 1934). WARREN: Johnsonburg (Torrey, 1934) and Kittatiny Mountain (Torrey, 1933). The New Jersey specimens are not definite as to form; but *f. clavata* (Ach.) Vainio, which is well figured by Robbins and Blake (12, *pl.* 210, *f.* 9), is surely to be expected.

8. CLADONIA MACILENTA Hoffm. (4, p. 398). On earth and on thin soil over rocks. This species is listed by Austin from Closter (2, p. 165) and by Eckfeldt from Atco, Camden County, as well as from Bergen County (3, p. 373); but no New Jersey specimens referred to *C. macilenta* are to be found in either the Austin or the Eckfeldt collection. Torrey reports the species from the Pine Barrens and notes that *f. styracella* is the usual form (18, p. 121).

8a. CLADONIA MACILENTA *f.* STYRACELLA (Ach.) Vainio (4, p. 399; 12, *pl.* 210, *f.* 10; 18, *pl.* 1, *f.* 10). MORRIS: Green Pond Mountain (Dillman, 1934). The writer has seen no material of this form from the Pine Barrens.

8b.* CLADONIA MACILENTA *f.* TOMENTOSULA (Floerke) Aigret, Bull. Soc. Roy. Bot. Belgique 40: 86. 1901 (as *C. macilenta*

dd. *tomentosula*). *Capitularia macilentata* var. *tomentosula* Floerke, Ges. Naturf. Freunde Mag. 2: 214. 1818. OCEAN: Seaside Park (1932, det. Sandstede); apparently the first record for North America. The primary squamules of f. *tomentosula* are well developed, and the podetia are much like those of f. *styracella*, except that they are more robust and more densely sorediose. They are, in other words, simple or shortly and sparingly branched in the upper part, and the podetial surface is free (or nearly so) from squamules. European writers tend to subordinate f. *tomentosula* to f. *styracella*, giving the latter varietal rank.

9. CLADONIA DIDYMA (Fée) Vainio (5, p. 125; 18, pl. 1, f. 8). On decaying wood and on soil rich in humus. Torrey reports the species from the "Pine Barren swamps" and also from the Wawayanda cedar swamp (16, p. 167; 18, p. 122). OCEAN: near Forked River (*Dillman*, 1933); this specimen is indefinite as to form, but the other New Jersey specimens seen by the writer are referable to the following forms:—

9a.* CLADONIA DIDYMA f. MUSCIGENA (Eschw.) Vainio, Acta Soc. F. et Fl. Fennica 4: 141. 1887 (as *a. muscigena*). *C. muscigena* Eschw. in Martius, Fl. Brasil. 1¹: 262. 1833. OCEAN: Double Trouble (1932, det. Sandstede). SUSSEX: Wawayanda cedar swamp (*Torrey*, 1933, det. Sandstede). This form represents the more typical development of the species and is the form usually found in tropical and subtropical regions. It is larger than the following and often produces apothecia.

9b.* CLADONIA DIDYMA f. SUBULATA Sandst. (5, p. 127). BURLINGTON: Speedwell (1932). OCEAN: Double Trouble (1932), Seaside Park (1932), and near Whitings (*Torrey*, 1933). The podetia of this form are more slender than those of f. *muscigena* and are usually sterile.

Subsection 2. STRAMINEO-FLAVIDAE

10. CLADONIA PLEUROTA (Floerke) Schaer. (4, p. 400). On earth and on thin soil over rocks. BERGEN: Closter (*Austin*, without date, N. Y., listed in 2, p. 164, as *C. cornucopioides*). BURLINGTON: Brown's Mills (1932), Lower Bank (1932), and West Plains (*Lutz*, 1932, see 8, p. 12). MONMOUTH: Navesink (*Evans*, 1934). OCEAN: Lakehurst (*Torrey*, 1934). WARREN: Kittatiny Mountain (*Torrey*, 1933). Eckfeldt lists *C. cornuco-*

pioides from the Blue Mountains, Sussex County (3, p. 373), but no specimens so named are present in his collection. For figures of *C. pleurota* f. *decorata* Vainio, see Robbins and Blake (12, pl. 210, f. 12) and Torrey (18, pl. 1, f. 11). Some of the specimens listed above approach this form.

10a.* CLADONIA PLEUROTA var. FRONDESCENS (Nyl.) Oliv. (4, p. 403). BURLINGTON: Lower Bank (1932). OCEAN: Lakehurst (Torrey, 1934).

11.* CLADONIA RAVENELII Tuck. Syn. North Amer. Lich. 1: 254. 1882. On old wood. OCEAN: Seaside Park (1932, det. Sandstede). This interesting and variable species is mostly subtropical and tropical in its distribution, and its discovery in New Jersey represents a marked extension of its known range to the northward. It agrees with *C. macilenta* in giving a bright yellow color with KOH, but is distinguished by its minute primary squamules and by the granulate-verrucose surface of the podetia, which may or may not be cup-forming.

12. CLADONIA CRISTATELLA Tuck. (4, p. 403). On old wood and on soil rich in humus; widely distributed in New Jersey and very variable. Austin listed the species from Closter (2, p. 165) and Eckfeldt (3, p. 374) added Atco, Camden County (Eckfeldt), and May's Landing, Atlantic County (Peters). Vainio (22¹, p. 218) cites it simply from "New Jersey," on the basis of specimens collected by Miss Biddlecome. Torrey has since reported *C. cristatella* from Andover, Sussex County (17, p. 50), while Thompson has listed it from the Wawayanda cedar swamp (14, p. 21). Some of the specimens upon which these records were based are listed below under definite forms, but no specimens from May's Landing have been available for study.

12a. CLADONIA CRISTATELLA f. BEAUVOISII (Del.) Vainio (4, p. 405; 12, pl. 210, f. 14, in part; 18, pl. 1, f. 5, in part). ATLANTIC: Inskip (Blake, 1928, det. Robbins). BERGEN: Closter (Austin, no date, N. Y., listed in 2, p. 165, as *C. cristatella*). BURLINGTON: Bass River State Forest (Torrey, 1934), East Plains (Lutz, 1932, see 8, p. 12), Lower Bank (1932), New Gretna (Musch, 1928, det. Robbins), near Pemberton (E. C. and G. M. Leonard, 1928), and West Plains (Lutz, 1932, see 8, p. 12). CAMDEN: Atco (Eckfeldt, 1882, P., listed in 3, p. 374, as *C. cristatella*; Green, 1882, N. Y.). MONMOUTH: Navesink (Evans, 1934). OCEAN:

near Barnegat (*E. C. and G. M. Leonard*, 1928), Barnegat Island (*Torrey*, 1934), and Double Trouble (1932). PASSAIC: West Milford (*Torrey*, 1934).

12b. CLADONIA CRISTATELLA f. VESTITA Tuck. (4, p. 407; 12, *pl.* 210, *f.* 14, in part; 18, *pl.* 1, *f.* 5, in part). Reported from "New Jersey" by Tuckerman (20, p. 255) and by Vainio (22¹, p. 218) on the basis of specimens collected by Miss Biddlecome. These specimens, which are in the Tuckerman collection, are dated 1877 but are without further data. The writer has seen *f. vestita* also from the following stations:— ATLANTIC: Inskip (*Blake*, 1928, det. Robbins). BURLINGTON: near Chatsworth (*E. C. and G. M. Leonard*, 1928), near Pemberton (*E. C. and G. M. Leonard*, 1928), and West Plains (*Lutz*, 1932, see 8, p. 12). MONMOUTH: Navesink (*Evans*, 1934). OCEAN: Barnegat Island (*Torrey*, 1934), Double Trouble (1932) and New Egypt (*Mrs. Anderson*, 1932). PASSAIC: West Milford (*Torrey*, 1934). WARREN: Kittatiny Mountain (*Torrey*, 1933). The form has been reported also from Moonachie, Bergen County (see *Torrey*, 19, p. 132).

12c.* CLADONIA CRISTATELLA f. SQUAMOSISSIMA Robbins (4, p. 408). PASSAIC: West Milford (*Torrey*, 1934). WARREN: Kittatiny Mountain (*Torrey*, 1933).

12d.* CLADONIA CRISTATELLA f. SIMULATA Robbins (4, p. 409). BURLINGTON: New Gretna (*Musch*, 1928, det. Robbins).

12e.* CLADONIA CRISTATELLA f. SCYPHULIFERA Sandst. (6, p. 41). BURLINGTON: Lower Bank (1932). OCEAN: Dover Forge (*Dillman*, 1934).

12f.* CLADONIA CRISTATELLA f. OCHROCARPIA Tuck. (4, p. 409). BURLINGTON: Lower Bank (1932). OCEAN: Lakehurst (*Torrey*, 1934).

12g.* CLADONIA CRISTATELLA f. SQUAMULOSA Robbins (4, p. 410). OCEAN: Barnegat Island (*Torrey*, 1934).

13. CLADONIA INCRASSATA Floerke (5, p. 129; 12, *pl.* 210, *f.* 13, as *C. paludicola*; 18, *pl.* 1, *f.* 12). On decaying wood and peaty soil. The species has been reported by *Torrey* from the Pine Barrens (18, p. 123) and from Moonachie, Bergen County (19, p. 131), and by *Torrey* and *Thompson* from the Wawayanda cedar swamp (18, p. 123; 14, p. 21). The following specimens have been examined by the writer:— BURLINGTON: Lower Bank

(1932) and West Plains (*Torrey*, 1932). OCEAN: Dover Forge (*Dillman*, 1934), Double Trouble (1932), near Whitings (*Torrey*, 1933), and Wrangel Brook (*Torrey*, 1934). SUSSEX: Wawayanda cedar swamp (*Torrey*, 1933).

13a.* *CLADONIA INCRASSATA* f. *SQUAMULOSA* (Robbins) Evans (5, p. 129). BURLINGTON: West Plains (*Torrey*, 1932). OCEAN: Double Trouble (1932).

Section 2. OCHROPHAEAE

Subsection 1. UNCIALES

14. *CLADONIA UNCIALIS* (L.) Web. (4, p. 413; 12, *pl. 2, f. 1*). On earth in fields or open woods. This abundant and variable species is listed by Austin from Ocean County (2, p. 164), and this record is cited by Eckfeldt (3, p. 373). It was probably based on a specimen in the Tuckerman Herbarium, collected by Austin in the "Pines of New Jersey." A "var. *adunca* Ach." is listed also by Austin from Ocean County, and the same variety from Camden County is included in Eckfeldt's list. Apparently no New Jersey specimens bearing this varietal name have been preserved, but the Eckfeldt collection contains specimens of *C. uncialis*, correctly determined but somewhat indefinite as to form. These are listed below, together with other specimens belonging to the same category. *Torrey* reports *C. uncialis* from the Pine Barrens (18, p. 123). BERGEN: Closter (*Austin*, no date, N. Y.). BURLINGTON: Batsto (1932), Brown's Mills (1932), Lower Bank (1932), New Gretna (*Musch*, 1928, det. Robbins), and West Plains (*Lutz*, 1932, see 8, p. 12; *Evans*, 1932; *Miss Fulford*, 1932). OCEAN: Bamber Lake (*Dillman*, 1934), near Barnegat (*E. C. and G. M. Leonard*, 1928), Dover Forge (*Dillman*, 1934), near Forked River (*Dillman*, 1933), Hornerstown (*Torrey*, 1933), Lahaway (*Torrey*, 1933), Lakehurst (*Torrey*, 1934), Laurelton (*Torrey*, 1934), Seaside Park (1932), Davenport Branch of Tom's River (*Dillman*, 1934), and near Tom's River (*E. C. and G. M. Leonard*, 1928). PASSAIC: West Milford (*Torrey*, 1934). SUSSEX: Wawayanda Mountain (*Torrey*, 1933).

14a.* *CLADONIA UNCIALIS* f. *OBTUSATA* (Ach.) Vainio (4, p. 415; 12, *pl. 211, f. 1*, in part). BURLINGTON: New Gretna (*Musch*, 1928, det. Robbins). OCEAN: Seaside Park (1932).

14b. *CLADONIA UNCIALIS* f. *SUBOBTUSATA* Coem. (4, p. 416). BURLINGTON: New Gretna (*Musch*, 1928, det. Robbins) and

West Plains (*Lutz*, 1932, see 8, p. 12). OCEAN: Bamber Lake (*Dillman*, 1934) and near Forked River (*Dillman*, 1933, det. Sandstede).

14c.* *CLADONIA UNCIALIS* f. *DICRAEA* (Ach.) Vainio (4, p. 416; 12, *pl*, 211, *f*. 1, in part). BURLINGTON: New Gretna (*Musch*, 1928, det. Robbins and Sandstede).

14d.* *CLADONIA UNCIALIS* f. *SPINOSA* Oliv. (4, p. 417). BURLINGTON: New Gretna (*Musch*, 1928, det. Sandstede).

14e. *CLADONIA UNCIALIS* f. *SETIGERA* Anders (5, p. 134). BURLINGTON: West Plains (*Lutz*, 1932, see 8, p. 12). OCEAN: Lahaway (*Torrey*, 1933) and Laurelton (*Torrey*, 1934).

15. *CLADONIA CAROLINIANA* (Schwein.) Tuck. (5, p. 134). On earth in fields and open woods. Torrey reports the species from the Pine Barrens and notes that the three forms listed below "may be found . . . in south Jersey" (18, p. 124).

15a. *CLADONIA CAROLINIANA* f. *DILATATA* Evans (5, p. 138; 18, *pl*. 2, *f*. 2). BURLINGTON: Bass River State Forest (*Torrey*, 1934), Skit's Branch of Batsto River (*Torrey*, 1934), Lower Bank (1932), New Gretna (*Musch*, 1928, det. Robbins as *C. caroliniana*), and West Plains (*Lutz*, 1932, see 8, p. 12; *Evans*, 1932). CAMDEN: Atco (*Eckfeldt*, 1882, mixed with *C. uncialis*, P.; *Green*, no date, N. Y.). OCEAN: Bamber Lake (*Dillman*, 1934), Double Trouble (1932), Dover Forge (*Dillman*, 1934), near Forked River (*Dillman*, 1933), Lahaway (*Torrey*, 1933), Lakehurst (*Torrey*, 1934), and Seaside Park (1932). PASSAIC: near Hewitt (*Dillman*, 1934) and Skylands (*Britton*, 1917, N. Y.). SUSSEX: Wawayanda Mountain (*Torrey*, 1933).

15b. *CLADONIA CAROLINIANA* f. *FIBRILLOSA* Evans (5, p. 139). BURLINGTON: Bass River State Forest (*Torrey*, 1934), Skit's Branch of Batsto River (*Torrey*, 1934), and West Plains (*Lutz*, 1932, see 8, p. 12). CAMDEN: Atco (*Green*, no date, N. Y.). OCEAN: near Forked River (*Dillman*, 1933). SUSSEX: Wawayanda Mountain (*Torrey*, 1933).

15c. *CLADONIA CAROLINIANA* f. *TENUIRAMEA* Evans (5, p. 139). BURLINGTON: East Plains (*Lutz*, 1932, see 8, p. 12), Lower Bank (1932), New Gretna (*Musch*, 1928), Pleasant Mills (*Mrs. Anderson*, 1932), and West Plains (*Lutz*, 1932, see 8, p. 12). MONMOUTH: near Manasquan (*Plitt*, 1909). OCEAN: Barnegat Island (*Torrey*, 1934), near Barnegat (*E. C. and G. M. Leonard*,

1928; Killip, 1930) Double Trouble (1932), Lahaway (Torrey, 1933), and Seaside Park (1932).

Professor Plitt's specimens were distributed by Merrill in his Lichenes Exsiccati, No. 72, as a new species, under the name "*Cladonia tenuissimum* [sic] Merrill," and the station was incorrectly given as "near Anisquam." These specimens, in the writer's opinion, represent a slender development of f. *tenuiramea*. Merrill's name must be regarded as a *nomen nudum*, since it has not been adequately published. Sandstede, however (13, p. 44), refers to it in connection with *C. dimorphoclada* Robbins, now known as *C. caroliniana* f. *dimorphoclada* (Robbins) Evans (5, p. 137). The specific name is first given incorrectly as "*minutissima* Merrill," but the error is corrected on a supplementary page.

16. CLADONIA BORYI Tuck. (4, p. 417; 18, pl. 2, f. 3). On earth in fields and open woods. Torrey reports the species from the New Jersey Pine Barrens (18, p. 124), but only two specimens from the state have been seen by the writer. These may be referred to the following form:—

16a. CLADONIA BORYI f. RETICULATA (Russell) Merrill (5, p. 141). BURLINGTON: New Gretna (Musch, 1928, det. Robbins as *C. Boryi*). OCEAN: near Bamber Lake (Dillman, 1934).

Subsection 2. CHASMARIAE

Group 1. MICROPHYLLAE

17. CLADONIA FURCATA (Huds.) Schrad. (4, p. 420). On earth in fields and open woods and on thin soil over rocks. According to Austin's list (2, p. 164) *C. furcata* and the varieties *crispata*, *racemosa*, and *subulata* are all found at Closter, but no specimens referred to either var. *crispata* or var. *subulata* are preserved in his collections. In Eckfeldt's list (3, p. 373) the species is reported from both Bergen and Camden Counties, and the same three varieties are listed. Torrey reports the species from Andover (17, p. 50) and Thompson (14, p. 22) from the Wawayanda cedar swamp. The few New Jersey specimens of *C. furcata* and its forms, which have been studied by the writer, may now be listed. BERGEN: Closter (Austin, no date, N. Y.). WARREN: Kittatiny Mountain (Torrey, 1933). These two specimens consist of young plants and are indefinite as to form.

17a. CLADONIA FURCATA var. RACEMOSA (Hoffm.) Floerke (4, p. 422; 12, *pl.* 211, *f.* 4; 18, *pl.* 2, *f.* 4). BERGEN: Closter (*Austin*, no date, F., N. Y., see 2, p. 164). WARREN: Kittatiny Mountain (*Torrey*, 1933).

17ab.* CLADONIA FURCATA var. RACEMOSA f. SQUAMULIFERA Sandst. (5, p. 153). BERGEN: Closter (*Austin*, no date, F., N. Y.). MORRIS: Oak Ridge (*Torrey*, 1934). SUSSEX: Wawayanda Mountain (*Torrey*, 1933). WARREN: Kittatiny Mountain (*Torrey*, 1933) and near Millbrook (*Torrey*, 1934).

18. CLADONIA FLORIDANA Vainio in Sandstede, *Clad. Exsic 1196*. 1922; Robbins, *Rhodora* 29: 136. *pl.* 157. 1927. On exposed sandy soil; first reported from New Jersey by Blake (1). ATLANTIC: Inskip (*Blake*, 1928, det. Robbins). BURLINGTON: Brown's Mills (1932), East Plains (*Lutz*, 1932, see 8, p. 12), Lower Bank (1932), Speedwell (1932), and West Plains (*Lutz*, 1932, see 8, p. 12). OCEAN: Double Trouble (1932), Lakehurst (*Torrey*, 1934), and Seaside Park (1932). Although *C. floridana* was based on specimens collected by Severin Rapp in Florida, its known range now extends as far north as eastern Long Island and the Cape Cod region. It has not been found, however, in either Connecticut or Rhode Island. The occurrence of the species in the Pine Barrens of New Jersey has been noted by *Torrey* (18, p. 126).

A full description of *C. floridana* has been published by Robbins (10), who recognized five different forms. His account emphasizes the fact that both the primary squamules and the podetia give a distinct yellow color with KOH. The podetia are further distinguished by having a smooth cortex, which is never sorediose, and by being usually more or less branched above. The branches are short and rigid and the axils are usually, but not invariably, "round-perforate." The tips of the branches in sterile plants are pointed and cupless but in fertile plants may be obsoletely cup-forming. Both squamulose and esquamulose forms occur.

18a.* CLADONIA FLORIDANA f. TYPICA Robbins, *Rhodora* 29: 137. *pl.* 157, *f.* 5. 1927. BURLINGTON: New Gretna (*Musch*, 1928, det. Robbins) and West Plains (*Miss Fulford*, 1932). OCEAN: Dover Forge (*Dillman*, 1934). The podetia in this form are both fertile and squamulose.

18b. CLADONIA FLORIDANA f. ESQUAMOSA Robbins, *Rhodora* 29: 137, *pl.* 157, *f.* 4. ATLANTIC: Inskip (*Blake*, 1928, det. Robbins). BURLINGTON: New Gretna (*Musch*, 1928, det. Robbins) and West Plains (*Lutz*, 1932, see 8, p. 12). The podetia are fertile but without squamules.

19.* CLADONIA SANTENSIS Tuck. *Am. Jour. Sci.* II. 25: 427. 1858. OCEAN: Dover Forge (*Dillman*, 1934), Lakehurst (*Torrey*, 1934), near Laurelton (*Torrey*, 1934), and near Whitings (*Torrey*, 1933, determination verified by Sandstede). The type-material of *C. santensis* was collected by H. W. Ravenel at Santee Canal, South Carolina, and the species has been found also in Florida by Rapp. Its discovery in New Jersey represents a marked extension of its known range to the northward. The species agrees with *C. floridana* in giving a vivid yellow color with KOH but shows distinctive features, not only in the primary thallus, but also in the podetia. These features are clearly brought out in the description by Robbins (10, p. 136). As shown by this account the primary squamules of *C. santensis* are "laciniate to dentate-crenate" and the cortex of the podetia is "globose-areolate." In *C. floridana*, on the other hand, the primary squamules are "subentire or dentate to sublobate," and the cortex of the podetia is "smooth, subrugose or slightly cracked."

20. CLADONIA SQUAMOSA (Scop.) Hoffm. (4, p. 432). On earth in open woods, on logs, and on thin soil over rocks. In Austin's list (2, p. 164) *C. squamosa* and the varieties *delicata* and *caespiticia* are recorded from Closter. In Eckfeldt's list (3, p. 373) the varieties are rightfully given specific rank and are recorded from the Pine Barrens, as well as from Bergen County. The specimens here listed under the species are not definite as to form. BERGEN: Closter (*Austin*, 1864, F., see 20, p. 246). BURLINGTON: Speedwell (1932). MORRIS: Green Pond Mountain (*Dillman*, 1934). OCEAN: Bamber Lake (*Dillman*, 1934), Double Trouble (1932), Hornerstown (*Torrey*, 1933), Laurelton (*Torrey*, 1934), and near Whitings (*Torrey*, 1933). PASSAIC: Green Pond (*Bowen*, 1933, listed by *Torrey*, 18, p. 126, as *C. turgida* f. *scyphifera*) and near Hewitt (*Dillman*, 1934). SUSSEX: Wawayanda Mountain (*Torrey*, 1933). WARREN: Kittatiny Mountain (*Torrey*, 1933).

20a.* CLADONIA SQUAMOSA f. FRONDOSA (Del.) Mass. Lich.

Ital. Exsic. 292b. 1855; *Cenomyce squamosa* δ . *frondosa* Del. in Duby, Bot. Gall. 625. 1830. WARREN: Kittatiny Mountain (Torrey, 1933, det. Sandstede); apparently the first record for North America. The primary squamules in this form are large and pinnately lobed, and the short podetia are densely squamulose.

20b.* CLADONIA SQUAMOSA f. PHYLLOPODA Vainio (6, p. 46). WARREN: Kittatiny Mountain (Torrey, 1933, det. Sandstede).

20c. CLADONIA SQUAMOSA f. LEVICORTICATA Sandst. (4, p. 435; 12, pl. 211, f. 5, in part). BURLINGTON: East and West Plains (Lutz, 1932, see 8, p. 12). OCEAN: near Barnegat (E. C. and G. M. Leonard, 1928) and Seaside Park (1932).

20ca. CLADONIA SQUAMOSA f. LEVICORTICATA m. PSEUDOCRISPATA Sandst. (4, p. 436). BURLINGTON: Bass River State Forest (Torrey, 1934), near Chatsworth (E. C. and G. M. Leonard, 1928), Lower Bank (1932) and West Plains (Lutz, 1932, det. Sandstede, see 8, p. 12). OCEAN: near Barnegat (E. C. and G. M. Leonard, 1928), near Forked River (Dillman, 1934), and Laurelton (Torrey, 1934).

20cb. CLADONIA SQUAMOSA f. LEVICORTICATA m. RIGIDA (Del.) Evans (4, p. 436; 18, pl. 2, f. 5, in part). Torrey says this is the commonest form in the New Jersey Pine Barrens (see 18, p. 125). ATLANTIC: Inskip (Blake, 1928, det. Robbins). BURLINGTON: Atsion (Miss Fulford, 1932), Bass River State Forest (Torrey, 1934), Batsto (1932), Brown's Mills (1932), Lower Branch (1932), and West Plains (Lutz, 1932, see 8, p. 13). MORRIS: Green Pond Mountain (Dillman, 1933). OCEAN: Bamber Lake (Dillman, 1934), near Forked River (Dillman, 1934), Hornerstown (Torrey, 1933), Lakehurst (Torrey, 1934), Seaside Park (1932), Davenport Branch of Tom's River (Dillman, 1934), and Wrangel Brook (Torrey, 1934). WARREN: Kittatiny Mountain (Torrey, 1933). Several of these determinations were made or verified by Sandstede.

20d.* CLADONIA SQUAMOSA f. EPIPHYLLA (Arn.) Sandst. in Rabenhorst, Kryptogamen-Flora 9, Abt. 4²: 278. 1931. *C. crispata* (*epiphylla*) Arn. in Rehm, Clad. Exsic. 367. 1889. MONMOUTH: Navesink (Evans, 1934, det. Sandstede). OCEAN: near Barnegat (E. C. and G. M. Leonard, 1928). New to North America. The podetia of *f. epiphylla*, as shown by Sandstede's description, are destitute of squamules, usually cup-forming,

and only 1-7 mm. in height. Except for their small size they bear a resemblance to the podetia of f. *levicorticata* m. *pseudocrispata*.

21. CLADONIA DELICATA (Ehrh.) Floerke (4, p. 438; 18, pl. 3, f. 1). On rotten stumps and logs. The New Jersey specimens examined are referable to the following form:—

21a. CLADONIA DELICATA f. QUERCINA (Pers.) Vainio (4, p. 439). BERGEN: Closter (*Austin*, no date, N. Y., listed in 2, p. 164, as *C. squamosa* var. *delicata*). OCEAN: Bamber Lake (*Dillman*, 1934), Dover Forge (*Dillman*, 1934), and near Forked River (*Dillman*, 1934). PASSAIC: Franklin Clove (*Torrey*, 1933, see 18, p. 126) and Green Pond Mountain (*Dillman*, 1934). SUSSEX: Wawayanda cedar swamp (*Torrey*, 1933, see 18, p. 126, and also 14, p. 22).

22. CLADONIA CAESPITICIA (Pers.) Floerke (4, p. 439; 12, pl. 211, f. 6; 18, pl. 3, f. 5). On earth and thin soil over rocks. BERGEN: Closter (*Austin*, no date, F., N. Y., listed in 2, p. 164, as *C. squamosa* var. *caespiticia*). MONMOUTH: Highlands and Navesink (*Evans*, 1934). SUSSEX: Wawayanda Mountain and cedar swamp (*Torrey*, 1933, see 18, p. 126). WARREN: Kittatiny Mountain (*Torrey*, 1933).

22a.* CLADONIA CAESPITICIA f. CORTICATA Sandst. Abhandl. Naturw. Ver. Bremen 25: 182. 1922 (as modification); in Rabenhorst, Kryptogamen-Flora 9, Abt. 4²: 292. 1931 (as form). OCEAN: Lakehurst (*Torrey*, 1934, det. Sandstede). New to North America. In the usual forms of *C. caespiticia* the very short podetia are destitute of a cortex and appear translucent; in f. *corticata* a distinct cortex is present, the surface appears opaque, and podetial squamules may be developed.

Group 2. MEGAPHYLLAE

23.* CLADONIA APODOCARPA Robbins (4, p. 440; 12, pl. 211, f. 7). BERGEN: Closter (*Austin*, no date, N. Y., listed in 2, p. 164, as *C. turgida*). SUSSEX: Wawayanda Mountain (*Torrey*, 1933). WARREN: near Millbrook (*Torrey*, 1934). The related *C. turgida* (Ehrh.) Hoffm. is listed by Austin from Closter and by Eckfeldt (3, p. 372) from Blue Mountains, Warren County, as well as from Bergen County. Two of Austin's specimens from Closter are in his collection at the New York Botanical Garden.

These, in the opinion of the writer, represent *C. apodocarpa* and are included in the above list. The Blue Mountain specimens are not in the Eckfeldt collection, and a later record for the species from Passaic County, as shown on page 96, was based on specimens of *C. squamosa*. Under the circumstances it does not seem advisable to consider *C. turgida* a member of the New Jersey flora.

Subsection 3. CLAUSAE

Group 1. PODOSTELIDES

24. CLADONIA MITRULA Tuck. (4, p. 444). On earth, often on sandy banks. This species was collected at Closter by Austin as long ago as 1861, and the following records are based on his specimens: 2, p. 164; 3, p. 372, in part; 20, p. 147; 21, p. 240; and 22², p. 50. Eckfeldt (3, p. 372) lists the species also from Camden and Sussex Counties, and Torrey has recently noted its occurrence at Andover (17, p. 50). The New Jersey specimens studied by the writer are referable to the following forms:—

24a. CLADONIA MITRULA f. IMBRICATULA (Nyl.) Vainio (4, p. 444; 12, *pl.* 211, *f.* 8; 18, *pl.* 3, *f.* 3). BERGEN: Closter (*Austin*, 1861, 1867, F., N. Y.) and Palisades (*Austin*, 1876). BURLINGTON: near Pemberton (*E. C. and G. M. Leonard*, 1928). CAMDEN: Atco (*Eckfeldt*, 1882, P.). OCEAN: New Egypt (*Mr. and Mrs. Taylor*, 1932). PASSAIC: Green Pond Mountain (*Dillman*, 1934). UNION: Watchung Reservation (*Torrey*, 1932). WARREN: Kittatiny Mountain (*Torrey*, 1932). No specimens from Sussex County are in the Eckfeldt collection.

24b.* CLADONIA MITRULA f. PALLIDA Robbins (4, p. 445). WARREN: Kittatiny Mountain (*Torrey*, 1933).

The related species *C. cariosa* (Ach.) Spreng., which has sometimes been confused with *C. mitrula* by North American lichenists, is reported by Austin from Closter (2, p. 164) and by Eckfeldt from Bergen and Camden Counties (3, p. 372). The Austin collection contains a single New Jersey specimen referred to *C. cariosa*. This specimen is labeled "Palisades, 1876," and, as noted above, represents *C. mitrula* f. *imbricatula*. The specimens from Camden County were collected by Eckfeldt himself, according to his list, but are not represented in his collection. There is, however, a specimen from Atco, Camden

County, collected by Green in 1882 and referred to *C. cariosa*. This specimen has sorediose, cup-forming podetia and is clearly a member of the *C. chlorophaea*-group. There is no convincing evidence, therefore, that the true *C. cariosa* has been found in New Jersey.

25. CLADONIA CLAVULIFERA Vainio (4, p. 446). On earth in fields or on thin soil over rocks. The New Jersey specimens are referable to the following forms:—

25a. CLADONIA CLAVULIFERA f. NUDICAULIS Evans (4, p. 447; 12, *pl.* 212, *f.* 1, in part; 18, *pl.* 3, *f.* 7, in part). BURLINGTON: New Gretna (*Musch*, 1928) and West Plains (*Lutz*, 1932, see 8, p. 13). OCEAN: Double Trouble (1932), Lakehurst (*Torrey*, 1934), and Seaside Park (1932). *Torrey* (18, p. 127) lists this form from the Pine Barrens and from Franklin Lake, Passaic County.

25b.* CLADONIA CLAVULIFERA f. SUBVESTITA Robbins (4, p. 447; 12, *pl.* 212, *f.* 1, in part). BURLINGTON: New Gretna (*Musch*, 1928, det. Robbins). OCEAN: Seaside Park (1932).

25c. CLADONIA CLAVULIFERA f. SUBFASTIGIATA Robbins (4, p. 448). WARREN: Kittatiny Mountain (*Torrey*, 1933). *Torrey* reports this form also from Franklin Lake (15, p. 47).

26.* CLADONIA SUBCARIOSA Nyl. (4, p. 449). On earth in fields or on thin soil over rocks. The New Jersey specimens represent the following form:—

26a.* CLADONIA SUBCARIOSA f. EVOLUTA Vainio (4, p. 450; 12, *pl.* 211, *f.* 9; 18, *pl.* 3, *f.* 8, in part). BERGEN: Closter (*Austin*, no date, F.), listed in 2, p. 164, as *C. pyxidata* var. *symphicarpa* and in 3, p. 371, as *C. symphicarpa*. MORRIS: Green Pond Mountain (*Dillman*, 1934). SUSSEX: Wawayanda Mountain (*Torrey*, 1933). *Eckfeldt* (3, p. 372) lists also *C. symphicarpa* var. *epiphylla* from New Jersey, without citing definite localities, but there are no specimens so named in his collection.

Group 2. THALLOSTELIDES

27. CLADONIA VERTICILLATA (Hoffm.) Schaer. (4, p. 458). On earth in fields or on banks. This species is included in *Austin's* and *Eckfeldt's* lists under the name "*C. gracilis* var. *verticillata* Fr." (2, p. 164; 3, p. 372). *Austin* reports it from Closter, and *Eckfeldt* gives two additional stations: Weehaw-

ken, *Gerard*, and Newfield, *Eckfeldt*. The specimens upon which these records are based have apparently not been preserved; there are no specimens from Weehawken or Newfield in the Eckfeldt collection, and neither of the two New Jersey specimens in the Austin collection is labeled "Closter."

In addition to "var. *verticillata*" Austin lists three other varieties under *C. gracilis*, namely: var. *hybrida* Fr., var. *elongata* Fr., and var. *symphicarpa* Tuck. The first two of these are listed also by Eckfeldt. The third of these varieties is now regarded as a synonym of *C. subcariosa*, but vars. *hybrida* and *elongata* are still included under *C. gracilis* by Vainio, who gives var. *hybrida* as a synonym under *C. gracilis* var. *dilatata* (see 22²: 88. 1894). Although Eckfeldt gives definite stations for vars. *hybrida* and *elongata*, there are no New Jersey specimens referred to these varieties in his collection. The Austin collection, however, contains a specimen labeled "var. *elongata*" from Closter, although neither the typical form of the species nor var. *hybrida* is represented. The specimen in question should be referred to *C. nemoxyna* (see page 105) and is mixed with immature plants of *C. furcata*. There is no adequate evidence, therefore, that the true *C. gracilis*, as at present defined, occurs in New Jersey.

Austin's New Jersey material of "*C. gracilis* var. *verticillata*," which came from the "Pines of New Jersey," is in poor condition but apparently represents an immature state of *C. calycantha*. This species, in some of its forms, approaches *C. verticillata* very closely, and the line between the two may be difficult to draw. In the writer's opinion, however, the specimens listed below represent the true *C. verticillata*, which seems to be more abundant at higher altitudes than in the Pine Barrens.

27a. CLADONIA VERTICILLATA f. EVOLUTA (Th. Fr.) Stein (4, p. 459; 12, pl. 212, f. 7). MORRIS: Green Pond Mountain (*Dillman*, 1934). OCEAN: near Forked River (*Dillman*, 1933). SUSSEX: Wawayanda Mountain (*Torrey*, 1933). WARREN: Kittingy Mountain (*Torrey*, 1933).

28. CLADONIA CALYCANTHA Del. in Nylander, *Flora* 38: 673. 1855 (*nomen nudum*); *Ann. Sci. Nat. Bot.* IV. 11: 209. 1859; *Syn. Meth. Lich.* 192. 1860. In sandy places and on old logs in

cedar swamps. BURLINGTON: East Plains (Lutz, 1932, see 8, p. 13) and West Plains (Lutz, 1932; Evans, 1932; Miss Fulford, 1932). CAMDEN: Atco (Green, 1882, N. Y., P., perhaps the material upon which Fink's New Jersey record for *C. verticillata* is based, see 7, p. 87). OCEAN: near Barnegat (E. C. and G. M. Leonard, 1928), Double Trouble (1932), Lakehurst (Torrey, 1934), Laurelton (Torrey, 1934), Seaside Park (1932), and near Whiting's (Torrey, 1933). Several of these determinations were made or verified by Sandstede. Torrey has recently reported *C. calycantha* from the Pine Barrens (18, p. 128).

The present species was named in manuscript by Delise and listed without description by Nylander in 1855, as noted above. This record was based on specimens collected by W. Lechler in Peru. In the other two citations the species is again listed and is accompanied by very brief comments, hardly sufficient to constitute adequate publication. Vainio, however, gives a detailed description of the species (22², p. 199), together with a long list of stations from Asia, North America, and South America. His most northern station is Miquelon Island, where the plant was found by Delamare; and specimens from this locality were distributed by Arnold (Lich. Exsic. 1149) under the name "*Cladonia cervicornis verticillata* Hoff." Vainio gives no other North American stations for *C. calycantha* north of Mexico and the West Indies, but the species has since been recorded from Florida (see Sandstede 13, p. 57), as well as from New Jersey.

The podetia of *C. calycantha* agree with those of *C. verticillata* in being cup-forming and in proliferating from the centers of the cups. In distinguishing the species from its immediate allies Nylander emphasized the presence of scattered white spots in the cortex, similar to those found in *C. degenerans* (Floerke) Spreng., but Vainio states that such spots are inconstant. The differential characters drawn from the cups are apparently more satisfactory. In typical *C. verticillata* these expand more gradually than the cups of *C. calycantha*, they are somewhat thicker at the margins, and the latter are subentire or shortly dentate from the presence of sessile apothecia or spermagonia. In *C. calycantha* the margins of the cups are more definitely dentate or even irregularly incised from the presence of stipitate apothecia.

According to Vainio the number of proliferations in *C. calycantha* may be as high as twelve, whereas in *C. verticillata* the number never exceeds six. This distinction, unfortunately, is not of wide application. In many specimens of *C. calycantha* the number of proliferations is fewer than six, in young podetia only a single proliferation may be present, and even this may be rudimentary. Vainio's careful descriptions of the histology of the two species bring out very few differences between them. In the writer's experience, however, the podetial cortex in *C. verticillata* is more continuous and thicker than in *C. calycantha*, being 20–30 μ thick in the first and only 10–20 μ thick in the second. This difference shows clearly in cross-sections, but further observations will be necessary to prove its constancy.

28a.* CLADONIA CALYCANTHA f. FOLIOSA Vainio, Acta Soc. F. et Fennica 10: 203. 1894 (18, pl. 4, f. 4, as *C. calycantha*). BURLINGTON: Speedwell (1932) and West Plains (1932). OCEAN: Bamber Lake (*Dillman*, 1934), near Barnegat (*E. C. and G. M. Leonard*, 1928), Double Trouble (1932), Dover Forge (*Dillman*, 1934), Lakehurst (*Torrey*, 1934), Laurelton (*Torrey*, 1934), Davenport Branch of Tom's River (*Dillman*, 1934), and near Whiting's (*Torrey*, 1933). The podetia in this form are more or less strongly squamulose.

29. CLADONIA PYXIDATA (L.) Hoffm. (4, p. 462). On earth in fields and open woods. Austin's list (2, p. 164) records *C. pyxidata* from Closter, and Eckfeldt (3, p. 372) describes the species as common in New Jersey. The older writers, however, included both esorediose and sorediose forms under the species. Since the latter are now considered specifically distinct, the older records for *C. pyxidata* can be interpreted only by the study of the actual specimens upon which they were based. Unfortunately there are no New Jersey specimens so labeled in either the Austin or the Eckfeldt collections, and those in the Tuckerman collection, six in number, all are sorediose. The writer has seen only one New Jersey specimen, in fact, which is referable to the true *C. pyxidata*. This represents the following form:—

29aa.* CLADONIA PYXIDATA var. NEGLECTA (Floerke) Mass. f. SIMPLEX (Ach.) Harm. (4, p. 464; 12, pl. 212, f. 3). WARREN: Kittatiny Mountain (*Torrey*, 1933, det. Sandstede, as *C. pyxidata*).

30. CLADONIA CHLOROPHAEA (Floerke) Spreng. (4, p. 465). On earth in fields and open woods. The sorediose forms which used to be included under *C. pyxidata* are now referred by Sandstede to two closely related species, *C. chlorophaea* and *C. Grayi*, and the writer has pointed out the difficulty of distinguishing between them (5, p. 160). Torrey's conception of *C. chlorophaea* (17, p. 50; 18, p. 128) includes both species; but the two are kept apart, at least provisionally, in the present paper. The records for these two species (with two exceptions) are based on Sandstede's determinations. The New Jersey specimens in the Tuckerman Herbarium are not included, since these have not been re-examined. Only one of these, however, the specimen from Closter, is assigned to a definite station; the others are labeled simply "New Jersey." Sandstede refers the following specimens to *C. chlorophaea*:—OCEAN: Double Trouble (1932), Lahaway (*Torrey*, 1933), and Seaside Park (1932). These specimens, in part, represent f. *simplex* (Hoffm.) Arn. (see 4, p. 468). Torrey lists this form from Andover, Sussex County (17, p. 50) and, in addition, f. *carpophora* (Floerke) Anders and f. *pterygota* (Floerke) Vainio (see 4, p. 470).

30a.* CLADONIA CHLOROPHAEA var. PACHYPHYLLINA (Wallr.) Vainio (4, p. 472). WARREN: Kittatiny Mountain (*Torrey*, 1933, det. Sandstede).

31. CLADONIA GRAYI Merrill (5, p. 159). On earth in fields and open woods. BURLINGTON: New Gretna (*Musch*, 1928, det. Robbins) and West Plains (*Lutz*, 1932, see 8, p. 13; *Miss Fulford*, 1932; *Evans*, 1932). MONMOUTH: Navesink (*Evans*, 1934). OCEAN: Bamber Lake (*Dillman*, 1934), Double Trouble (1932), Laurelton (*Torrey*, 1934), and New Egypt (1932). PASSAIC: West Milford (*Torrey*, 1934). These records, with two exceptions, are based on Sandstede's determinations.

32. CLADONIA FIMBRIATA (L.) Fr. (4, p. 473). On earth in woods or on banks. Austin records *C. fimbriata* and its var. *adspersa* from Closter (2, p. 164), and Eckfeldt adds Camden County as a station for the typical form of the species. The older writers understood *C. fimbriata* in a very broad sense, and several of the forms which they included under it are now segregated out as distinct species. The New Jersey specimens upon which Austin's and Eckfeldt's records were based are ref-

erable to two of these segregates, *C. nemoxyyna* and *C. coniocraea*, but the following station may be given for *C. fimbriata* in its restricted sense:—OCEAN: Lakehurst (*Torrey*, 1934, det. Sandstede).

33.* CLADONIA NEMOXYNA (Ach.) Nyl. (4, p. 475; 18, pl. 4, f. 7, in part). On earth in old fields and on banks. BERGEN: Closter (*Austin*, no date, F., N. Y.; listed by *Austin*, 2, p. 164, as *C. fimbriata* in part, as *C. fimbriata* var. *adpersa* in part, and as *C. gracilis* var. *elongata*; and by *Eckfeldt*, 3, p. 372, under the same names, except that he substitutes the varietal name *tubaeformis* for *adpersa*) and Crystal Lake (*Dillman*, 1934). PASSAIC: Green Pond Mountain (*Dillman*, 1934). WARREN: Kittatiny Mountain (*Torrey*, 1933).

33a.* CLADONIA NEMOXYNA f. FIBULA (Ach.) Vainio (4, p. 477; 18, pl. 4, f. 7, in part). PASSAIC: near Hewitt (*Dillman*, 1934). WARREN: Kittatiny Mountain (*Torrey*, 1933).

34.* CLADONIA OCHROCHLORA Floerke (6, p. 55). On logs and banks. WARREN: Kittatiny Mountain (*Torrey*, 1933).

35. CLADONIA CONIOCRAEA (Floerke) Spreng. (4, p. 478). On logs and banks; reported by *Torrey* from Andover, Sussex County (16, p. 50). The New Jersey specimens seen by the writer are referable to the following forms:—

35a.* CLADONIA CONIOCRAEA f. CERATODES (Floerke) Dalla Torre & Sarnth. (4, p. 479; 12, p. 212, f. 5, in part; 18, pl. 4, f. 6, in part). BERGEN: Closter (*Austin*, no date, F., N. Y.; listed by *Austin*, 2, p. 164, as *C. fimbriata* in part and as *C. fimbriata* var. *adpersa* in part; and by *Eckfeldt*, 3, p. 372, as *C. fimbriata* in part and as *C. fimbriata* var. *tubaeformis*). BURLINGTON: near Pemberton (*E. C. and G. M. Leonard*, 1928). CAMDEN: Atco (*Green*, 1882, P.). MONMOUTH: Navesink (*Evans*, 1934). OCEAN: New Egypt (1932) and near Whittings (*Torrey*, 1933). SUSSEX: Wawayanda Mountain, Vernon (*Torrey*, 1933). WARREN: Kittatiny Mountain (*Torrey*, 1933).

35b.* CLADONIA CONIOCRAEA f. TRUNCATA (Floerke) Dalla Torre & Sarnth. (4, p. 480; 12, p. 212, f. 5, in part; 18, pl. 4, f. 6, in part). BERGEN: Closter (*Austin*, no date, F., N. Y., listed by *Austin* and by *Eckfeldt* under the names cited above under f. *ceratodes*). CAMDEN: Atco (*Green*, 1882, P.). SUSSEX:

Wawayanda Mountain, Vernon (*Torrey*, 1933). WARREN: Kittatiny Mountain (*Torrey*, 1933).

35c.* CLADONIA CONIOCRAEA f. PYCNOTHELIZA (Nyl.) Vainio (5, p. 161). SUSSEX: Wawayanda Mountain, Vernon (*Torrey*, 1933).

36.* CLADONIA BORBONICA (Del.) Nyl. (4, p. 481). On logs, banks, and thin soil over rocks. Represented by the following form:—

36a.* CLADONIA BORBONICA f. CYLINDRICA Evans (4, p. 482). BURLINGTON: Speedwell (1932). PASSAIC: near Hewitt (*Dillman*, 1934). WARREN: Johnsonburg (*Torrey*, 1934) and Kittatiny Mountain (*Torrey*, 1933).

37.* CLADONIA PITYREA (Floerke) Fr. (4, p. 483). On earth and old wood. Austin's record for *C. degenerans* (Floerke) Spreng. (2, p. 164) was based on material from Closter. This material, according to a specimen in the Tuckerman Herbarium, is not referable to *C. degenerans*, as now defined, but apparently represents *C. pityrea*. Its fragmentary condition, unfortunately, makes a positive determination impossible. Eckfeldt (3, p. 372) lists *C. degenerans* from Sussex and Warren Counties, as well as from Bergen County, but there are no New Jersey specimens referred to this species in his collection. For the present, therefore, the occurrence of *C. degenerans* in the State must be considered very doubtful. Even *C. pityrea*, according to the available data, is a rare species in New Jersey, and the writer is able to list only one specimen of recent collection, as follows:—

37a.* CLADONIA PITYREA var. ZWACKHII Vainio f. SUBACUTA Vainio (4, p. 485). OCEAN: New Egypt (*Mrs. Anderson*, 1932).

Group 3. FOLIOSAE

38. CLADONIA STREPSILIS (Ach.) Vainio (4, p. 487). On earth in fields and open woods. BURLINGTON: West Plains (*Lutz*, 1932, see 8, p. 13). The species is listed by *Torrey* from the Pine Barrens (18, p. 129) under several forms.

38a. CLADONIA STREPSILIS f. GLABRATA Vainio (4, p. 488; 18, pl. 3, f. 4, in part). BURLINGTON: East and West Plains (*Lutz*, 1932, see 8, p. 13) and Lower Bank (1932).

38b. CLADONIA STREPSILIS f. CORALLOIDEA (Ach.) Vainio (4, p. 489; 12, pl. 212, f. 10; 18, pl. 3, f. 4, in part). BURLINGTON:

West Plains (*Lutz*, 1932, see 8, p. 13) and Lower Bank (1932).

38c. *CLADONIA STREPSILIS* f. *SUBSESSILIS* Vainio (4, p. 489; 18, *pl.* 3, *f.* 4, in part). BURLINGTON: near Chatsworth (*E. C. & G. M. Leonard*, 1928) and East Plains (*Lutz*, 1932, see 8, p. 13).

38d.* *CLADONIA STREPSILIS* f. *COMPACTA* Anders (5, p. 163). OCEAN: Hornerstown (*Torrey*, 1933, det. Sandstede).

Group 4. OCHROLEUCAE

39. *CLADONIA PIEDMONTENSIS* Merrill (4, p. 490; 11, *pl.* 187; 12, *pl.* 212, *f.* 11). On rich soil in fields and open woods. This species is listed from Closter by Austin (2, p. 164), under the name *C. lepidota*, and from Bergen and Salem Counties by Eckfeldt (3, p. 372), under the same name. Austin's specimens of "*C. lepidota*" are labeled simply "New Jersey." These specimens were examined by Robbins (10, p. 103) and referred, at least by implication, to the two forms listed below. There are no New Jersey specimens labeled *C. lepidota* in the Eckfeldt collection. The true *C. lepidota* Nyl., as defined by recent writers, is a northern species related to *C. degenerans*.

39a. *CLADONIA PIEDMONTENSIS* f. *LEPIDIFERA* (Vainio) Robbins (4, p. 491; 11, *pl.* 187, *f.* 14-18; 12, *pl.* 212, *f.* 11, in part). BERGEN: Closter (*Austin*, 1860, F., N. Y., det. Robbins). Although these specimens are not actually labeled "Closter," they probably represent the material cited by Austin and by Eckfeldt (under Bergen County), as well as by Tuckerman (20, p. 148; 21, p. 250) and by Vainio (22², p. 420). OCEAN: Laurelton (*Torrey*, 1934).

39b. *CLADONIA PIEDMONTENSIS* f. *INTERMEDIA* Robbins, *Rhodora* 31: 104. *pl.* 187, *f.* 8-10. 1929. BERGEN: Closter (*Austin*, 1860, F., det. Robbins, mixed with the material cited under the preceding form). In f. *intermedia* both large and small apothecia are produced, and the podetia are smooth or nearly so.

39.* *CLADONIA PIEDMONTENSIS* f. *SQUAMULOSA* Robbins (4, p. 491; 11, *pl.* 187, *f.* 14-18). OCEAN: Laurelton (*Torrey*, 1934).

EXCLUDED SPECIES

The ten species enumerated below, which are recorded from New Jersey by Eckfeldt and (in most cases) by Austin, are not included in the preceding list. In some cases they appear under

different names, but in other cases the specimens upon which the records were based are either inconclusive or unavailable.

1. *C. alpestris* (reported as *C. rangiferina* var. *alpestris*);
2. *C. cariosa* (see *C. mitrula* f. *imbricatula*);
3. *C. cornucopioides* (see *C. pleurota*);
4. *C. cornuta*;
5. *C. degenerans* (see *C. pityrea*);
6. *C. gracilis* (see *C. verticillata* f. *evoluta*);
7. *C. leporina*;
8. *C. lepidota* (see *C. piedmontensis*);
9. *C. symphicarpa* (see *C. subcariosa* f. *evoluta*);
10. *C. turgida* (see *C. apodocarpa*).

Such species as *C. alpestris*, *C. cariosa*, *C. cornuta*, *C. degenerans*, *C. gracilis*, *C. lepidota*, and *C. turgida* are predominantly northern in their distribution and would hardly be expected in New Jersey, although one or two of them have been found in the higher Alleghanies. Such a species as *C. leporina*, on the other hand, which has a southern range, might well be expected.

LITERATURE CITED

1. **Blake, S. F.** *Cladonia floridana* in New Jersey. *Rhodora* **31**: 56. 1929.
2. **Britton, N. L.** A preliminary catalogue of the flora of New Jersey. Geological Survey of New Jersey, xi, 233. New Brunswick, 1881.
3. ———. Catalogue of plants found in New Jersey. Final Rept. State Geologist **2**: 27-649. 1889.
4. **Evans, A. W.** The *Cladoniae* of Connecticut. *Trans. Connecticut Acad.* **30**: 357-510. 1930.
5. ———. Notes on the *Cladoniae* of Connecticut. *Rhodora* **34**: 121-142, 153-164. 1932.
6. ———. Notes on the *Cladoniae* of Connecticut. II. *Rhodora* **37**: 33-57. 1935.
7. **Fink, B.** Further notes on *Cladonias*.—IV. *Bryologist* **7**: 85-88. pl. 11. 1904.
8. **Lutz, H. J.** Ecological relations in the Pitch Pine Plains of Southern New Jersey. Yale University, School of Forestry, Bull. 38. ix, 80, 18 figs. New Haven, 1934.

9. **Merrill, G. K.** Lichen notes No. 12. The *Cladonia* specimens of "Lichenes Boreali-Americani." *Bryologist* 12: 90-94. 1909.
10. **Robbins, C. A.** The identity of *Cladonia Beaumontii*. *Rhodora* 29: 133-138. *pl.* 157. 1927.
11. ———. The identity of *Cladonia lepidota* Fries. *Rhodora* 31: 101-106. *pl.* 187. 1929.
12. **Robbins, C. A., & Blake, S. F.** *Cladonia* in the District of Columbia and vicinity. *Rhodora* 33: 145-159. *pl.* 210-212. 1931.
13. **Sandstede, H.** *Cladoniae* exsiccatae. Berichtigte Uebersicht. 1-66. Westerstede, 1930.
14. **Thompson, J. W., Jr.** Field trip of December 10 [1933]. *Torreyia* 34: 21-22. 1934.
15. **Torrey, R. H.** Lichen observations on winter walks of the Club. *Torreyia* 32: 45-47. 1932.
16. ———. Unusual lichen occurrences. *Torreyia* 32: 166-167. 1932.
17. ———. Lichen excursion at Andover, New Jersey. *Torreyia* 33: 49-50. 1933.
18. ———. *Cladoniae* in the range of the Torrey Botanical Club. *Torreyia* 33: 109-129. *pl.* 1-4. 1933.
19. ———. Swamp survivals near Moonachie, New Jersey. *Torreyia* 33: 130-132. 1933.
20. **Tuckerman, E.** *Genera Lichenum*: an arrangement of the North American lichens. xv, 283. Amherst, 1872.
21. ———. A synopsis of the North American lichens: Part I, comprising the *Parmeliacei*, *Cladonieei*, and *Coenogonieei*. xx, 262. Boston, 1882.
22. **Vainio, E.** *Monographia Cladoniarum* universalis. Pars prima. *Acta Soc. F. et Fl. Fennica* 4: 1-510. 1887. Pars secunda. *Ibid.* 10: 1-499. 1894. Pars tertia *Ibid.* 14: 1-268. 1897.

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